

IN THE CLAIMS

Minor formalities are corrected in Claims 8, 14, 18 and 19. Further, Claim 13 is canceled but its verbage is imported into Claim 8, therefore Claim 8 should now be allowable, thereby making Claim 12 Allowable as dependent on an Allowable Claim. Further, Claim 15 is canceled but its verbage is imported into Claim 14, threby making Claim 14 Allowable. Further, Claim 19 is amended to include the language of Claim 8 and should therefore now also be Allowable. Please cancel Claims 1-7, 13, 15 and 17 and Allow Claims 8, 12, 14, 16, 18 and 19.

1. (canceled): A method of investigating a sample comprised of a sequence of at least one layer of material, each said layer having a thicknesses on the order of less than about 100 Angstroms, said method comprising the steps of:

- a) providing two samples, at least one of which comprises at least one thin layer of material thereon;
- b) obtaining spectroscopic data for each of the samples by causing polychromatic electromagnetic radiation to interact with each said sample and then enter a detector to the end that spectra for both samples are provided;
- c) subtracting the obtained spectra from one another;
- d) determining differences in said spectra; and
- e) analyzing said differences in the spectra.

2. (canceled): A method of investigating a sample comprised of

a sequence of high and low "K" dielectric constant layers of material which each have thicknesses on the order of less than about 100 Angstroms each comprising the steps of:

- a) providing two samples, at least one of which comprises a sequence of high and low "K" dielectric constant layers;
- b) obtaining spectroscopic data for each of the samples by causing polychromatic electromagnetic radiation to interact with each said sample and then enter a detector to the end that spectra for both samples are provided;
- c) subtracting the obtained spectra from one another;
- d) determining differences in said spectra; and
- e) analyzing said differences in the spectra.

3. (canceled): A method as in Claim 2, in which one sample is without an intentional sequence of high and low "K" layers present thereupon, and the second of which has a sequence of high and low "K" layers present thereupon.

4. (canceled): A method as in Claim 3, in which one sample is bulk material with minimal native oxide layer.

5. (canceled): A method as in Claim 2, in which both samples have a sequence of high and low "K" layers present thereupon.

6. (canceled): A method as in Claim 5, in which both samples are meant to have the same fabricated structure, and in which the difference of the spectroscopic spectra indicates an undesirable difference in the fabrication process.

7. (canceled): A method as in Claim 5, in which both samples are meant to have different fabricated structure, and in which the difference of the spectroscopic spectra indicates a desired difference in the fabrication process.

8. (currently amended): A method of tracking fabrication of a sample comprising a sequence of high and low "K" dielectric constant layers of materials which each have thickness on the order of less than 100 Angstroms comprising the steps of:

- a) fabricating a reference sample which comprises a sequence of high and low "K" dielectric constant layers;
- b) obtaining spectroscopic data therefrom as said reference sample is fabricated;
- c) fabricating a second sample which is meant to be the same as the reference sample;
- d) obtaining spectroscopic data therefrom as said second sample is fabricated and in real time detecting differences in said spectra as compared to the corresponding reference sample spectroscopic data; and
- e) modifying fabrication parameters to minimize said differences;

in which the spectroscopic data for each of the two samples is derived from ellipsometric PSI and/or DELTA vs. wavelength, and comprises a difference in at least one selection from the group consisting of:

$$N = \cos(2\psi);$$

$$C = \sin(2\Psi)\cos(\Delta);$$

$$S = \sin(2\Psi)\sin(\Delta);$$

calculated for each of the two samples;

said method being further distinguished in that the electromagnetic radiation comprises wavelengths in at least one selection from the group consisting of:

FIR;
IR;
NIR-VIS-NUV;
UV;
DUV; and
VUV.

9. (canceled): A method as in Claim 8 in which the spectroscopic data for each of the two samples is ellipsometric PSI and/or DELTA vs. wavelength.

10. (canceled): A method as in Claim 8 in which the spectroscopic data for each of the two samples is derived from ellipsometric PSI and/or DELTA vs. wavelength, and comprises a difference in at least one selection from the group consisting of:

$$N = \cos(2\Psi);$$

$$C = \sin(2\Psi)\cos(\Delta);$$

$$S = \sin(2\Psi)\sin(\Delta);$$

calculated for each of the two samples.

11. (canceled): A method as in Claim 8 in which the

spectroscopic data for each of the two samples is derived from ellipsometric PSI and/or DELTA vs. wavelength, and comprises a difference in an RMS value calculated from:

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

where:

$$\begin{aligned} N_1 &= \cos(2\Psi); \\ C_1 &= \sin(2\Psi)\cos(\Delta); \\ S_1 &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

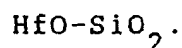
correspond to one of said samples and:

$$\begin{aligned} N_2 &= \cos(2\Psi); \\ C_2 &= \sin(2\Psi)\cos(\Delta); \\ S_2 &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

corresponds to the second sample.

12. (previously amended): A method as in Claim 8 in which the layers of a sample which has a sequence of high and low "K" layers present thereupon includes at least one layer[[s]] comprised of at least one selection from the group consisting of:

SiO₂;
SiON;
HfO;



13. (canceled): A method as in Claim 8 in which the electromagnetic radiation comprises wavelengths in at least one selection from the group consisting of:

FIR;
IR;
NIR-VIS-NUV;
UV;
DUV; and
VUV.

14. (currently amended): A method for evaluating thickness of an ultrathin film comprising the steps of:

a) providing a system comprising an optically absorbing substrate with a layer of optically transparent material on a surface thereof which is greater than about 250 Angstroms deep;

b) causing a beam of spectroscopic electromagnetic radiation to impinge on said surface of said optically transparent material at an oblique angle, interact with said system and via a detector determining spectroscopic ellipsometric PSI (Ψ) and DELTA (Δ), and therefrom calculating at least one selection from the group consisting of:

$$\begin{aligned} N_o &= \cos(2\Psi); \\ C_o &= \sin(2\Psi)\cos(\Delta); \\ S_o &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

c) depositing an ultrathin film of absorbing material on a surface of said layer of optically transparent material and again

causing a beam of spectroscopic electromagnetic radiation to impinge on said surface of said optically transparent material at an oblique angle, interact with said system and via a detector obtaining spectroscopic ellipsometric PSI (Ψ) and DELTA (Δ), and therefrom calculating at-least-one-selection-from-the-group consisting-of:

$$N_f = \cos(2\Psi);$$

$$C_f = \sin(2\Psi)\cos(\Delta);$$

$$S_f = \sin(2\Psi)\sin(\Delta);$$

d) over a spectroscopic range of wavelengths, determining a parameter vs. wavelength which depends on at-least-one differences between selected-from-the-group-consisting-of:

$$(N_f - N_o);$$

$$(C_f - C_o); \text{ and}$$

$$(S_f - S_o);$$

said parameter being an RMS value calculated from:

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

e) using peaks in the parameter determined in step d to evaluate thickness of the ultrathin film.

15. (canceled): A method for evaluating thickness of an

ultrathin film as in Claim 13 14, in which the parameter determined in step d is an RMS value calculated from:

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

16. (previously amended): A method for evaluating thickness of an ultrathin film as in Claim 13 14, in which the depth of the layer of optically transparent material is 1000 Angstroms or greater.

17. (canceled): A method for evaluating thickness of an ultrathin film as in Claim 13 14, in which the depth of the layer of optically transparent material is 1000 Angstroms or greater and in which the parameter determined in step d is an RMS value calculated from:

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

18. (currently amended): A method for evaluating thickness of an ultrathin film as in Claim 14, in which optical constants of the ultrathin film of absorbing material on a surface of said layer of optically transparent material are also determined.

19. (currently amended): A method of tracking fabrication of a

sample comprising a sequence of high and low "K" dielectric constant layers of materials which each have thickness on the order of less than 100 Angstroms comprising the steps of:

- a) fabricating a reference sample which comprises a sequence of high and low "K" dielectric constant layers;
- b) obtaining spectroscopic data therefrom as said reference sample is fabricated;
- c) fabricating a second sample which is meant to be the same as the reference sample
- d) obtaining spectroscopic data therefrom as said second sample is fabricated and in real time detecting differences in said spectra as compared to the corresponding reference sample spectroscopic data; and
- e) modifying fabrication parameters to minimize said differences;

in which the spectroscopic data for each of the two samples is derived from ellipsometric PSI and/or DELTA vs. wavelength, and comprises a difference in an RMS value calculated from:

$$\sqrt{\frac{(N_f - N_o)^2 + (C_f - C_o)^2 + (S_f - S_o)^2}{3}}$$

where:

$$\begin{aligned} N_f &= \cos(2\Psi); \\ C_f &= \sin(2\Psi)\cos(\Delta); \\ S_f &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

correspond to one of said samples and:

$$\begin{aligned} N_o &= \cos(2\Psi); \\ C_o &= \sin(2\Psi)\cos(\Delta); \\ S_o &= \sin(2\Psi)\sin(\Delta); \end{aligned}$$

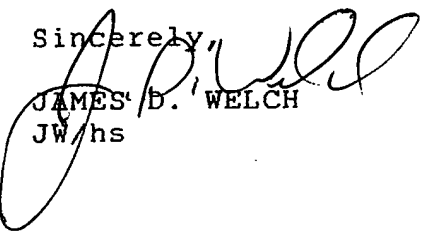
corresponds to the second sample;

said method being further distinguished in that the electromagnetic radiation comprises wavelengths in at least one selection from the group consisting of:

FIR;
IR;
NIR-VIS-NUV;
UV;
DUV; and
VUV.

Applicant now believes that the Examiner identified problems are overcome and therefore respectfully requests Allowance of Claims 8, 12, 14, 16, 18 and 19. Also, thanks is extended to the Examiner for working through this with me. This effort has been a series of mis-steps.

Sincerely,



JAMES D. WELCH
JW/hs